Understanding Students' Satisfaction with OERs as Course Materials

Purpose. In this paper, we introduce a survey instrument to measure three components of students' perceptions of open and affordable course materials—Quality, Integration, and Experience—and discuss its reliability and predictive validity.

Design. We distributed an end-of-semester online survey to students enrolled in sections of twelve courses that adopted OER in Fall 2016, as well as conducting a within-interview survey with the instructors of those courses. We calculated the descriptive statistics from the responses to the student survey, as well as examining the inter-item and inter-rater reliability of the instrument. Finally, we explored correlations in the data gathered through both the student and faculty surveys.

Findings. We found that both students and faculty were generally pleased with the quality and experience of using open and affordable digital materials. We also found that our three survey subscales had strong inter-item reliability, and that the Quality and Experience subscales had predictive validity in terms of whether students would choose a traditional or digital text in future courses.

Originality/value. In addition to providing evidence in terms of the full survey instrument's reliability and predictive validity, factor analysis indicates that a short scale of Quality and Experience Likert scale items could be used by practitioners to effectively assess satisfaction of digital materials among traditionally aged undergraduate students.

Keywords: open educational resources, OER, affordable learning, digital course materials

Introduction

In order to ameliorate rising textbook costs, in 2015 [University name] launched the Affordable Learning Exchange (ALX) program, to offer grants that support faculty in replacing their traditional textbooks with high-quality digital open educational resources (OER) or library materials. Under the first cohort, faculty adopted affordable materials for 12 courses in Fall 2016, and a second cohort is working on a similar number this year. The projects in the first two cohorts are projected to save students nearly $1.3 million annually.

Although each of the faculty who participated in the Fall 2016 cohort shared the common goal of adopting open or affordable course materials, they were not a monolithic group. They represented a range of disciplines, including art education, molecular genetics, psychology, geography, mathematics, and other subject areas. In addition, the ways in which they implemented open and affordable materials ranged from replacing their traditional textbook with an existing open textbook, to curating a collection of open or library materials, to writing their

own textbook or software application.

As we designed our evaluation and assessment framework for ALX, we reviewed existing surveys that capture student perceptions of OER quality and usability. Most existing OER survey items are either tailored to the features of a specific OER being evaluated (e.g., Annand, 2008), or rely on fairly broad and holistic satisfaction items (e.g., Bliss *et al.*, 2013; Lindshield and Adhikari, 2013). Given that we needed a set of items which would apply consistently and appropriately to the wide variety of affordable materials within the ALX program, the tailored approach was not a good fit. However, the broad and holistic approach would not allow us to capture specific areas for improvement. Open-ended student responses in previous studies (Bliss *et al.*, 2013; Hilton *et al*., 2012) suggest that some students are dissatisfied with OER in terms of both issues related to general textbook quality (e.g., visual quality, readability) and issues specific to digital materials (e.g., ability to annotate, ability to access the materials when needed). In addition, studies of academic digital content (not necessarily of OERs) also suggest that some students experience physical discomfort while using digital media (such as eye or neck strain), have difficulty shutting out distractions while using a digital device, have difficulty navigating or tracking their progress, or generally have difficulty reading and retaining digital material (Annand, 2008; Eden and Eshet- Alkalai, 2013; Noyes and Garland, 2008; Stoop *et al.*, 2013a, 2013b). We wanted to assess the extent to which those "digital dissatisfiers" were relevant to our student population, in order to prioritize areas of program development, including potential training or support for both ALX instructors and students.

In addition to program improvement, a second purpose of our own survey was to inform a larger quantitative analysis of student outcomes. For that analysis, we plan to use aggregated

course-level student and faculty perceptions of the quality of course materials as a moderator variable between adoption of open and affordable materials and improved student outcomes; however, we were concerned that if faculty did not fully integrate the materials into the course, then the materials' quality would be irrelevant to student outcomes (see Gurung and Martin, 2011). We also suspected we would find a stronger relationship between the materials' quality and students' overall satisfaction with digital course materials if the instructor required students to review the materials.

Accordingly, we designed our survey to measure three components of students' perceptions of course materials: Quality (characteristics of the materials), Integration (whether students needed to review the materials), and Experience (the impact of the materials on the student's experience of the course). To capture issues related to general textbook Quality, we adapted and blended items from a well-validated survey of textbook quality (Gurung and Martin, 2011) with items from a previous OER survey (Bliss *et al.*, 2013). Integration items were adapted from Gurung and Martin (2011), and we drafted most of the Experience items based on "digital dissatisfiers" reported in the literature. In this paper, we introduce the survey instrument and discuss its reliability and predictive validity.

Methods

The Quality, Integration, and Experience items were measured using 21 Likert scale items (Table 1). In addition, a final overall Satisfaction item (similar to one used in previous studies, e.g., Bliss *et al.*, 2013) asked students to imagine a future course and to indicate whether they would prefer to enrol1 in a section that used a traditional printed text, or that used digital materials similar to the one in their current course.

We distributed an end-of-semester online survey to N = 2,368 students enrolled in OER

sections of twelve courses that adopted ALX OER in Fall 2016. Ten of the courses were the focus of the initial ALX grant program, and two had adopted some of the same course materials but were not explicitly part of the grant. $N = 681$ students consented to participate, and $N = 611$ responded to most items.

As part of our larger evaluation and improvement framework, we also conducted in-depth interviews with 12 instructors across the 10 original focus courses [1]; within the interview context, instructors provided their own ratings for Quality and Integration items. For the Quality subscale, we did not ask instructors the final two questions (regarding comfort and value), as these items were more relevant to students than faculty; and while we asked students to anchor their judgment of materials in comparison to other courses they had taken, we asked instructors to anchor their judgment in comparison to the previous version of the same course. Integration subscale items were parallel between students and instructors, with some minor necessary recasting (e.g., "this instructor" became "you"). The instructor within-interview survey also included additional items on implementation, which we will not discuss here.

To provide an overall sense of students' assessments of their course's materials, for each of the survey scale items we calculated results for the "typical course," by first calculating the twelve within-course means and standard deviations, and then aggregating across the course-level means and standard deviations. We also calculated the proportion of students who responded to each item with a rating of 1 or 2 and the proportion who responded with a rating of 4 or 5. In order to establish the reliability and validity of the survey items, we conducted several analyses. First, using exploratory factor analysis on the student sample, we investigated whether the 21 Likert items indeed load onto the theorized set of subscales, and explored the internal reliability of each subscale. Second, we explored inter-rater reliability across students by

calculating an intraclass correlation using a mixed-modeling approach. Third, for the Quality and Integration subscales, we correlated student and instructor responses using both a simple Pearson correlation and a mixed-modeling approach. Fourth, we assessed whether the subscales predicted the final overall Satisfaction item, and investigated whether the instructor integration of materials (based on the student's report) moderated the predictive relationship.

Results

Table 1 shows that, overall, students' responses were very positive. For Quality and Experience items, mean ratings typically ranged from 3.5 – 4.0, suggesting that students thought the ALX course's materials were somewhat better than those of courses they had taken; and indeed, students were much more likely to rate each item with a 4 or 5 (Somewhat or Much Better / Easier) than with a 1 or 2 (Much or Somewhat Worse / Harder). For example, 63% felt their course's digital materials were more relevant than a typical printed textbook (while only 5% felt they were less relevant), and 66% felt the digital materials were easier to access (while only 8% felt access was more difficult). However, we have flagged a few areas for general improvement (e.g., 18% felt the quality of study aids was worse; 26% had more difficulty shutting out distractions while studying, and 17% had more difficulty taking useful notes on the material), as well as areas for improvement within specific courses. In terms of Integration items, about half of students felt they needed to review the OER materials Almost Every Time or Every Time, but some students disagreed; for example, 14% felt they Never or Almost Never needed to review the materials in order to understand in-class content. In terms of the overall Satisfaction item, 66% of respondents said that in future courses, they would prefer to use digital materials like those in this course, while 12% would prefer traditional printed texts and 21% had no preference.

[insert Table 1 here]

The 21 student survey scale items were included in an exploratory factor analysis with principle-axis factor extraction and varimax rotation. There were three factors with eigenvalues above 1; prior to rotation, the first factor explained 49% of the variance across all items, with the second and third factors contributing another 10% and 6% respectively, while after rotation, the first factor explained 23% of the common variance, with the second and third contributing another 23% and 10% respectively. Examination of factor loadings indicated that with a three-factor solution, each item's factor loadings lined up cleanly with the three subscales, with Quality items loading on Factor 2 (with loadings ranging from 0.50 to 0.74), Integration items loading on Factor 3 (ranging from 0.57 to 0.82), and Experience items loading on Factor 1 (ranging from 0.53 to 0.71). For each subscale, Cronbach's alphas indicated a strong level of inter-item reliability (student Quality = 0.91, Integration = 0.79, Experience = 0.93). To assist practitioners who may be interested in administering a shorter scale tapping students' overall perception of quality and experience, we also examined the results of a one-factor solution (explaining 49% of total variance). The strongest-loading items (all above 0.75) were those related to engaging and interesting writing, understandable and clear writing, relevant content, ease of reading and understanding, ease of reviewing and remembering material, and ease of preparing for class. When considering only these six items as a "Short Scale," Cronbach's alpha was very strong at 0.91.

Next, we assessed the extent of agreement between students in the same course by calculating an intraclass correlation for each subscale as well the Short Scale, using SAS PROC MIXED (see Singer, 1998). The Quality, Experience, and Short Scale items were most relevant to the course level, and thus we used course membership (N = 12) as the random effect for these

scales; however, the Integration items may be more relevant to the particular instructor teaching the course; accordingly, we used Course By Instructor membership (N = 20) as the random effect for Integration. For each scale, the random variance component was significant at $p < 0.05$, indicating that courses did substantially vary from one another in terms of students' ratings. For example, course materials which were newly-created by one instructor (hereafter referred to by the pseudonym Dr. Tailor) to meet the unique needs of that course's students received Quality ratings more than half a point higher than the average ALX course (EBLUP estimate =0.64, SE pred = 0.15, $p < 0.001$), while course materials which another instructor (hereafter referred to as Dr. Adopt) pulled from an existing open text with little modification received Quality ratings about a third of a point lower than the average ALX course (EBLUP estimate = -0.39, SE pred = 0.15, p <0.001). While the courses differed significantly in terms of students' ratings, the intraclass correlations (a measure of whether students had more similar ratings to classmates within their course, compared to students in other courses) were quite mild (Quality = 0.17, Integration = 0.22, Experience = 0.15, Short Scale = 0.19).

In terms of the faculty survey responses, instructors typically rated each Quality and Integration item between a 3 and 4. Faculty ratings were noticeably different from those of students for only one item: Faculty rated "relevance of content" substantially higher than students, with a mean of 4.67. While we had too few faculty respondents to conduct a parallel factor analysis, Cronbach's alpha on the two faculty subscales indicated an acceptable level of inter-item reliability for each (faculty Quality = 0.80, Integration = 0.70).

We next correlated each student's Quality and Integration subscale with their relevant instructor's subscale. To do so, we first recalculated each student's Quality subscale score to exclude the final two items, making the subscale parallel to the faculty version; we also dropped

students whose instructors were not included in the survey. We did not expect a strong student-faculty correlation for the Quality subscale, given that students and instructors were anchoring their judgments of quality in slightly different contexts; but we expected a relatively strong correlation for Integration. Using simple Pearson correlations with $N = 480$ students, the student-faculty correlation for Quality was only $r = 0.17$, while the correlation for Integration was even lower at $r = 0.09$. While both correlations were statistically significant, the statistical test is biased due to a violation of the assumption that all observations are independent from each other. Although the student intraclass correlations reported above are not large and thus may not substantially affect standard errors, the faculty responses are entirely duplicated across students in their courses. To correct for this, we re-ran the PROC MIXED models for Quality (excluding students' two final items) and Integration with the subset of students whose instructors were included in the survey, using instructor as a random effect. The student intraclass correlations remained similarly low (Quality = 0.20, Integration = 0.16). For each model, we added the instructor's relevant subscale as a fixed effect at the second level of the model, and neither subscale was a significant predictor (for the Quality model, the instructor subscale estimate = 0.16, SE = 0.17, *n.s.*; for the Integration model, the instructor subscale estimate = 0.11, SE = 0.15, *n.s.*).

To better understand the lack of relationship between student and instructor responses, Figure 1 plots the aggregated course-level student Quality subscale against each instructor's subscale response. The figure suggests the correlation is attenuated due to a restriction of range (see Goodwin & Leech, 2006): on average, students within *all* courses rated their course materials quite highly, as did every instructor but one. Note that the farthest upper-right observation belongs to Dr. Tailor's course, while the outlier in the lower-right quadrant belongs

to Dr. Adopt's course. Similarly, the Integration subscale showed a tight cluster in the upper-right quadrant with the exception of two instructors inhabiting the lower-right quadrant (i.e., they believed they had not strongly integrated the materials into the course, while their students felt that they did).

[insert Figure 1 here]

We next investigated which subscales were most predictive of the final overall Satisfaction item, and investigated whether Integration (based on students' reports) moderated the relationship between Quality and Satisfaction. Table 2 shows the Quality, Integration, and Experience means across the three levels of the overall Satisfaction item (N = 611). We also include the short Quality/Experience scale in Table 2 for interested practitioners.

[insert Table 2 here]

Students who would opt for a traditional text in the future rated their current OER as being quite similar in Quality and Experience compared to other courses they had taken, while students who had no preference rated the OER materials higher, and students who would opt for digital course materials rated the OER materials higher still. Students' judgment of whether they needed to review the materials followed a similar stepwise increase across levels.

As we were primarily interested in why some students would prefer to use a traditional text, we recoded the overall Satisfaction item as binary (1 = prefer traditional text, 0 = no preference / prefer digital materials) and conducted a logistic regression including mean-centered versions of the student Quality, Integration, and Experience subscales, the interactions between Integration and the other two subscales, and fixed effects for course membership (which removes course-specific effects from the estimation of other parameters and helps adjust standard errors for intraclass clustering). The two interactions did not approach significance and were dropped

from the model. Quality was a statistically significant predictor (logit = -1.53, SE = 0.34, odds ratio = 0.22, p <0.001), Integration was not significant (logit = -0.66, SE = 0.18, odds ratio = 0.94, *n.s.*), and Experience was marginally significant (logit = -0.66, SE = 0.34, odds ratio = 0.52, p = .05). Figure 2 plots the relationship between Quality and the model-predicted probability that each student would opt for a traditional textbook. Among students who rated their digital course materials' Quality as a 3.5 or above, the average probability of opting for a traditional text in the future was only 0.05; among those who rated Quality between a 3 and 3.5, the average probability was 0.12, and among those who rated Quality below 3, the average probability was 0.58.

[insert Figure 2 here]

The model also suggested that, after controlling for the three subscales, the twelve courses significantly differed in their likelihood of students opting for a traditional text in a similar course in the future. Entering the three subscales first and the course fixed effects as a subsequent block, the omnibus test of coefficients for the course block was statistically significant (chi-square = 21.23, df = 11, p < 0.03), suggesting that some unknown course characteristics also predict student preferences for a traditional textbook, outside of students' perceptions of Quality and Experience as captured in the survey. For example, as we might expect based on Quality and Experience ratings, students in Dr. Tailor's course were very unlikely to opt for a traditional text in the future (with an average model-predicted probability of 0.00) while those in Dr. Adopt's course were more likely (with an, average probability of 0.13). However, the course with the highest likelihood of students opting for a traditional textbook (with an average probability of 0.29) did not have the lowest Quality and Experience ratings – but it is a highly-technical course in which many students traditionally struggle, which raises the

possibility that a poor course experience or personal performance could influence students' preference for a traditional text.

For interested practitioners, we also conducted a model using the Short Scale to predict students' preference for a traditional textbook, controlling for course fixed effects, and found that it was a strong predictor (logit = -1.79, SE = 0.25, odds ratio = 0.17, $p < 0.001$).

Conclusion

Similar to most previous studies of OER, we found that both students and faculty were generally pleased with the quality and experience of using open and affordable digital materials (for a review, see Hilton, 2016). We also found that our three survey subscales (and a Short Scale version of Quality/Experience) had strong inter-item reliability, and that the Quality and Experience subscales (and their short version) had predictive validity in terms of whether students would choose a traditional or digital text in future courses.

However, we also encountered some unexpected results. First, student ratings were not strongly clustered within courses, which might suggest a lack of inter-rater reliability. In part, this is due to most students being uniformly pleased with their course's OER, and believing they were required to read it (regardless of which course they were in). On the other hand, student responses differed between courses to enough of an extent that we could statistically distinguish between the highest- and lowest-rated courses (e.g., Dr. Tailor versus Dr. Adopt), in ways that seemed consistent with our qualitative understanding of how those course materials were developed and delivered. Remaining student-specific variability may be due to the idiosyncratic array of other courses each student is using as a standard of comparison, the extent to which each student is sensitive to "digital dissatisfiers," and the extent to which each student generally believes he or she does not need to review course materials in order to succeed at a personally-

acceptable level. Second, student ratings of Quality and Integration were not well-correlated with the relevant instructor's own ratings. For the Quality subscale, this may be due to the different anchors used by the two types of respondents (i.e., students comparing against the quality of other courses, versus faculty comparing against the quality of the prior version of their own course). But in general, the lack of correlation seems due to a restriction of range – and to the fact that one instructor was substantially more critical of her OER textbook than her students were, and two instructors believed they had not strongly integrated the materials into the course, while their students felt that they had. Third, we expected the Integration scale to moderate the relationship between Quality/Experience and students' overall interest in using digital OER in the future. However, even among students who Never or Almost Never needed to use the course materials, Quality and Experience were still positively related to their overall interest in digital OER.

In terms of program assessment and improvement, our current survey has not only been useful to confirm that (in general) students feel ALX's open and affordable course materials are of equal or better quality than traditional print materials, but also has helped us to diagnose specific areas for improvement. For example, we are considering how to improve the quality of study aids in future ALX courses, investigating opportunities to better integrate digital annotation capabilities and train students in their use, and planning strategies to help students block out distractions on digital devices.

In this paper, we have presented two versions of the survey (one with three subscales, and a short six-item version that focuses on Quality and Experience). Both have strong inter-item reliability and predictive validity in terms of student interest in future digital materials. Programs interested in a general assessment of OER quality, or which serve populations who are unlikely

to be sensitive to "digital dissatisfiers," may find the short scale most helpful. Programs interested in identifying areas for improvement, or who serve populations that may be concerned with digital access and success issues, may find the full set of three subscales most helpful.

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Endnotes

[1] Two of the ten focus courses had implemented ALX-funded course materials across multiple sections. For these courses, we interviewed/surveyed two different instructors: A lead instructor who developed the materials, and another instructor who adopted the materials in their own course section. Students in additional adopting sections of the course were surveyed (for a total of $N = 20$ combinations of courses and instructors), but their instructors were not interviewed/surveyed. For the two non-focus courses, instructors were not interviewed/surveyed.

For analyses that use both student and faculty survey responses, faculty $N = 12$ and student $N = 480$.

Table 1. Student survey scale items' typical course means and standard deviations and proportion of students using ratings 1-2 and 4-5

	Typical Mean (SD)	% 1-2 Ratings	% 4-5 Ratings
Quality. Compared to traditional printed textbooks or readings used in your other courses, how high-quality were this course's digital materials in terms of the following characteristics? (1 = Much Worse, 5 = Much Better)			
Good search capabilities (easy to find specific content)	3.86 (1.01)	9%	61%
High-quality visuals (layout, images, diagrams)	3.86 (1.22)	6%	62%
Engaging and interesting writing	3.84 (0.92)	8%	56%
Understandable and clear writing	3.88 (0.89)	8%	57%
Helpful and useful study aids (for example, review questions, quizzes, videos, or games)	3.58 (1.03)	18%	50%
Relevant content (to the particular course's focus and instructor expectations)	4.06 (0.87)	5%	63%
Current content (up-to-date with recent advances in the field)	4.10 (0.82)	3%	66%
Comfort while using (lack of eye strain, can relax comfortably while using)	3.65 (0.96)	14%	51%
Good value for the price I paid	4.50 (0.78)	3%	82%
Integration. To what extent were this course's materials integrated into assignments and assessments? (1=Never, 5=Every Time)			
Did this instructor explicitly make you review the course materials (for example, by requiring quizzes on them, or requiring you to discuss them in class)?	3.54 (0.56)	21%	50%
Was reviewing the course materials necessary to understand in-class material, lectures, or discussions?	3.66 (0.99)	14%	50%
Was reviewing the course materials necessary to doing well on this course's assessments (quizzes, papers, exams)?	3.93 (0.68)	11%	65%
Experience. Compared to traditional printed textbooks or readings used in your other courses, did this course's digital materials make it easier or harder to do the following activities? (1=Much Harder, 5 = Much Easier)			
Access course materials whenever I needed them	4.09 (0.92)	8%	66%
Find and get started on the correct assignments in time	3.95 (1.22)	6%	60%
Read and understand the material	3.78 (0.94)	10%	51%
Shut out other distractions while studying	3.13 (1.06)	26%	29%
Take useful notes on the material	3.48 (0.98)	17%	37%

Complete assignments on time	3.73 (0.90)	4%	50%
Review and remember the material	3.65 (0.94)	12%	46%
Be prepared for class activities or discussions	3.73 (0.84)	7%	47%
Collaborate with fellow students	3.47 (0.91)	12%	35%

Figure 1. Scatterplot of aggregated course-level student ratings of Quality and the relevant instructor's Quality rating

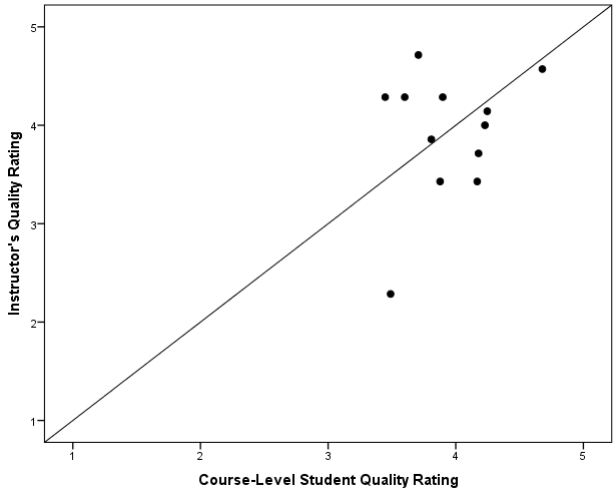

Table 2. Student subscale and Short Scale means and standard errors across levels of the overall Satisfaction item

In a future course, student would prefer….	Quality Mean (SE)	Integration Mean (SE)	Experience Mean (SE)	Short Scale Mean (SE)
Traditional printed texts	3.01 (0.09)	3.15 (0.11)	2.83 (0.09)	2.81 (0.10)
No preference	3.46 (0.05)	3.37 (0.08)	3.22 (0.05)	3.31 (0.05)
Digital materials like those in this course	4.08 (0.03)	3.72 (0.04)	3.81 (0.04)	3.96 (0.03)
Total	*3.81 (0.03)*	*3.57 (0.04)*	*3.56 (0.03)*	*3.68 (0.03)*

Figure 2. Scatterplot of student Quality subscale and model-predicted probability of opting for a traditional text